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**CARD WITH EMBEDDED BISTABLE DISPLAY HAVING SHORT AND  
LONG TERM INFORMATION**

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**CARD WITH EMBEDDED BISTABLE DISPLAY HAVING SHORT AND  
LONG TERM INFORMATION**

**FIELD OF THE INVENTION**

5                   The present invention relates to transaction cards having an embedded bistable display and a display writing system.

**BACKGROUND OF THE INVENTION**

10               There is a growing use of transaction cards having a changeable value amount associated to it. These cards typically have long term information devices such as a magnetic strip or chip embedded that relates to a database holding the current value for that card. Other long term information on the card may be printed images done by way of, for instance, a thermal printing device. With subsequent usage of the card, a reduced or increased value is assessed to the  
15               database relating to the card. The consumer, however, has no visual indication on the card showing what amount remains until the next use. There is, therefore, a need for an indicator which shows the short term amounts at any given time on the card throughout its life. Such cards could be used for allotments of credits, such as phone cards and arcade games, and monetary amounts such as gift cards and  
20               pre-set credit cards. This can be accomplished with a thin, bistable display embedded within the card showing the ever changing amounts. A read/write device at the point of sale will send the card data from the magnetic strip of memory chip to the database and receive back new short term information to be electronically written to the card prior to withdrawing it from the read/write  
25               device. Subsequent use of the card continues to change the short term visual information in accordance with the database.

                  There is therefore a need for an improved transaction card that holds long term data and images as well as short term visible information.

30                                   **SUMMARY OF THE INVENTION**

                  The need is met according to the present invention by providing a transaction card system that includes a transaction card with a display tag for

displaying short term information, the character display having optical states that are stable without power and viewable from one side of the display tag, and an array of electrical contacts for electrically addressing the character display from the other side of the tag, a contact window through which the contacts are  
5 accessible, machine readable data on the card, and long term information printed on the transaction card; a transaction card writer having a reader for reading information stored on the magnetic stripe of the transaction card and having means for updating the short term information displayed on the transaction card; and a central computer connected to the transaction card writer having a database  
10 and a central processor for receiving the data read by the transaction card writer and generating display commands for the transaction card writer.

### **ADVANTAGES**

The invention has the advantage of providing a transaction card  
15 system that updates and displays short term information relating to the use of the transaction card with an inexpensive and easily manufactured transaction card that does not contain any active electronics.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

20 Fig. 1 is a front view of a character display tag according to the present invention;

Fig. 2 is a cross sectional view of a character display tag taken along lines 2-2 in Fig. 1;

25 Fig. 3 is an exploded back view of a transaction card according to the present invention;

Fig. 4 is an assembled back view of the transaction card of Fig. 3;

Fig. 5 is a cross section view of an assembled transaction card taken along 5-5 of Fig.4;

30 Fig. 6 is a perspective view of a transaction card writer used to electrically change the short term information on the transaction card according to the present invention;

Fig. 7 is a side view of the transaction card writer of Fig.6; and  
Fig. 8 is a schematic block diagram of a transaction card system  
according to the present invention.

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## **DETAILED DESCRIPTION OF THE INVENTION**

Referring to Figs. 1 and 2, a character display tag **10** is constructed by forming a conductive common electrode layer **12** on a substrate **15**. A layer of bistable liquid crystal material **18** is deposited, for example by roll coating, over the conductive common electrode layer **12**, leaving an exposed area **16** of layer **12**  
10 for making electrical contact. Electrically conductive character segments **20** are then formed, for example by thick film printing over the bistable liquid crystal layer **18**. The character segments **20** may be arranged as numbers 0-9, a slash, a decimal point, a dollar sign, or a cent sign. A dielectric layer **19** is then printed over the character segments **20**, leaving via holes **22** over each character segment  
15 **20**. Electrically conductive traces **21** are printed over the dielectric layer **19** which flows through the via holes **22**, making contact with the conductive character segments **20**.

The conductive traces **21** terminate at the bottom of the tag **10** to form a plurality of contact pads **40**. The optical state of the bistable liquid crystal  
20 material **18** between the character segments **20** and the electrode layer **12** can be changed by selectively applying drive voltages to the contact pads **40** which are electrically connected to the character segments **20** and the electrode layer **12**. Once the optical state of the bistable material has been changed, it remains in that state indefinitely without further power being applied to the electrodes. The  
25 character display tag can be made as shown for example in USSN 10/134,185, filed April 29, 2002 by Stephenson et al., which is incorporated herein by reference.

Referring to Fig. 3, a card body **25** is shown with a front window  
28 allowing front side viewing of tag **10** and a cap **30** to encapsulate the tag **10**  
30 within the card body **25** by a means of sealing, one of which is ultrasonic. The tag **10** is positioned within the card body **25** by way of locator darts **26**. The cap **30** is

placed in recess 32 of the back of card body 25. The cap 30 is ultrasonically sealed in the recess 32 to the card body 25.

Fig. 4 shows an assembled transaction card 35 with an opening 37 in cap 30 to allow external electrical contacts to reach contact pads 40 of tag 10.

5 The card also includes means for providing machine readable data, for example a magnetic strip 27 which holds stored data pertaining to the transaction card 35. Alternatively, the means for providing machine readable data may comprise an embedded memory chip with exposed contacts on the card body, an RFID chip embedded in the card body 25, or a bar code printed on the card body.

10 Fig. 5 is a section view derived from Fig. 4 showing an enlargement of the tag portion of the assembled transaction card 35. The cap 30 after being sealed into recess 32 becomes coplanar with the back of the card body 25, allowing uninterrupted insertion into a card writer.

Referring to Figs. 6 and 7, a transaction card writer 45 is shown  
15 which can read a magnetic strip 27 as well as write to the display tag 10. Upon insertion into a slot, a magnetic strip reader 48 reads the magnetic strip 27 to determine the card data stored on the strip and relates it to the stored data on a database. As insertion is completed, the card pushes against fingers 51, raising  
20 contact sled 56 by way of a camming angle 54 between the transaction card writer 45 and posts 55 of contact sled 56 which holds contact pins 52. When contact sled 56 is fully raised, the contact pins 52 come in contact with the contact pads 40 of display tag 10 allowing electrical signals to change the state of the  
conductive segments 20.

Fig. 8 shows a schematic block diagram of a transaction card  
25 system according to the present invention. A central computer 75 contains a database 70 having stored data pertaining to individual transaction cards 35. A transaction card writer 45 includes a reading device 48, which reads the machine readable data from the transaction card 35. Within transaction card writer 45 is a control circuit board 50 with a display driver controller 80, a plurality of contact  
30 pins 52, and wires 65 from the pins 52 to the control circuit board 50. Cable 67 is

connected between a controller **85** on the control circuit board **50** and to the central computer **75**.

A printer **95** such as a thermal printer, can be provided to print long term information on transaction card **35** when the card is first issued to a  
5 transaction card holder. The images originating from computer **75** are sent to the printer **95**. The printing of long term information can thus be done locally and customized with individual card issuer information and markings.

A transaction card writer **45** can also be provide as part of a terminal **90**, which can be used to originally issue or recharge value to the  
10 transaction card **35**. At original issue, the issuer of the card would indicate to the computer **75** via an operator interface, such as a keyboard **96**, the nature and value of the card. A new card would be printed by the printer **95** and written by transaction card writer **45** to show the value of the card. If additional value is desired for the transaction card **35**, the transaction card can be inserted into a  
15 transaction card writer **45** within the terminal **90**. The database **70** would recognize the card identification from the machine readable data on the card. Once the desired increased amount is paid for by either cash payment or charged from a credit or debit card, the value is updated in the database **70** by way of the central computer **75**. The new value is then sent to the transaction card writer **45**  
20 within the terminal **90** and written to the transaction card **35**. The transaction to increase the value of the card can be performed by a clerk, or can be performed automatically by the terminal **90**.

The transaction card system of the present invention can be used, for example, to provide a prepaid gift card; a prepaid game card; a preset limit  
25 credit card; a prepaid service card for services such as utilities, gasoline, telephone, transportation, college bookstores, cafeterias, theatre, or concerts; a cumulated credit card where an accumulated credit due to the use of the card is displayed on the card; a library card indicating when the book is due where the information stored in the card is the ID of a book and the information displayed on  
30 the card is the due date of the book; a club membership card where the short term information relates to club privileges; a video store card where the short term

information relates to a number of video rentals due to the holder of the card; a “frequent flyer” card where the short term information shows the number of miles (credits) accumulated.

For example, if the transaction card is a prepaid card, the following  
5 process could take place. The card would be purchased from a retailer for a given amount, e.g. \$50, and an account in that amount associated with the identifier on the card would be created in the database. The retailer would produce the card and write the prepaid amount into the card to show on the display tag. When a card holder uses the card to purchase a item or a service, the provider of the item  
10 or service would communicate the value of the transaction to the computer and the value would be deducted from the balance in the database and a new remaining balance would be displayed on the card.

In the example where the transaction card is a credit card with a cumulative limit, the issuer of the credit card would supply the card with an  
15 agreed upon credit limit which would be displayed on the card and recorded in the database. As each purchase is made with the card, the remaining credit value in the database would be updated and displayed on the card. When the credit value reaches zero, further credit would be denied to the card holder. When a payment is made toward the credit card, the database is updated to show the new available  
20 credit. The next time the credit card is used, the amount of remaining available credit is updated to show the balance of credit after the payment and any further transactions.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations  
25 and modifications can be effected within the spirit and scope of the invention.

## **PARTS LIST**

10	character display tag
12	common electrode layer
15	substrate
16	exposed area
18	bistable liquid crystal layer
19	dielectric layer
20	conductive character segments
21	conductive traces
22	via holes
25	card body
26	locator darts
27	magnetic strip
28	window
30	cap
32	backside recess
35	transaction card assembly
37	cap opening
40	tag contact pads
45	transaction card writer
48	magnetic strip reader
50	circuit board w/drivers
51	fingers
52	contact pins
54	camming angle
55	contact sled posts
56	contact sled
65	wires
67	cable
70	central computer database
75	central computer
80	display driver controller
85	card writer microprocessor
90	terminal
95	printer
96	keyboard